DEEP PENETRATION MAGNETOQUASISTATIC ARRAYS

ABSTRACT OF THE DISCLOSURE

The combination of giant magnetoresistive (GMR) sensing element arrays with shaped field, distributed drive windings provides a deep measurement capability for magnetic and/or conducting materials. Sensor designs are disclosed that use either sinusoidal or first order Bessel function shaped quasistatic field drive designs with a method to provide two magnetic field penetration depths within the same sensor footprint and at the same temporal excitation frequency. An easy to model drive construct supports substantial calibration requirement reduction and rapid generation of sensor response databases called measurement grids used for rapid estimation of multiple properties. Use of one deep penetration drive with an array of GMR sensing elements provides both high-resolution imaging and sensitivity deep into complex structures. This wide area scanning capability offers a substantial improvement over conventional eddy current sensors that have an inherent trade-off between depth of sensitivity and image resolution. Novel feedback methods for controlling the magnetic field at the GMR sensing elements improve robustness by eliminating effects of non-linear GMR transfer characteristics. The use of this feedback method, even with simple drive constructs, such as a simple rectangular drive with one or more GMR sensors inside our outside the drive winding region, offers substantial new capabilities for nondestructive testing and materials characterization.